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THE JUNE 21, 1967 EARTHQUAKE SERIES AT FAIRBANKS, ALASKA: AFTERSHOCK LOCATIONS, DEPTHS AND MAGNITUDES

by

Eduard Berg, Larry Gedney, Susumu Kubota, Ken Hanson and Jurgen Kienle

SCIENTIFIC REPORT

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K. B ‹Roff.

Eduard Berg   Keith B. Mather
                                                         Director
                                                         Geophysical Institute

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ABSTRACT

Aftershock recordings have been obtained to determine the extent of the fracture area which using some 50 shocks, was found to be an area of 10 x 15 km with the major axis roughly oriented in a NW-SE direction. Hypocenter depth varies from 6 to 19 km, with most of the shocks being confined to a depth of 10 to 13 km. It was found that the Jeffreys-Bullen velocities, V_p = 5.56 and V_s = 3.37 km/sec, represent a close approximation of the velocities in the area. Presented also are the telemeter network readings from June 21, 1800 GMT to July 14. These readings include the aftershocks of magnitude 2.5 ano upward.

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General Information

On June 21, 1967 four earthquakes occurred in the immediate vicinity of Fairbanks between 1804 and 1825 GMT. The first shock had a magnitude of 5.6, the second registered 4.3, the third and largest was 6.0 and the last one was magnitude 5.3. These magnitudes have been obtained from the Standard Wood Anderson horizontal Torsion Seismometers at the McKinley station MCK. The magnitudes obtained from MCK, at some 130 km distance from the epicentral area, are in substantial agreement with those reported for the three larger shocks by Pasadena: in chronological order, 5 1/2, 6 and 5 3/4 (Taylor, 1967).

The series of "main" shocks was immediately followed by a large number of aftershocks. Pedro Dome was the nearest permanent station in the network. At that station 70 earthquakes and possibly more were recorded during one hour period following the initial disturbances. The rate diminished to about 30 per hour on June 25 and was down to roughly 10 per hour in early July. Many of the larger shocks with a threshold around magnitude 2 1/2 have been felt in Fairbanks (see Figs. 7 and 8).

Also, many small aftershocks with magnitudes larger than zero have been located on the south eastern side of Fairbanks with a small tr_parted network over the epicentral area.

Geology

The Tanana Valley area is included in the general, large scale fault systems of Alaska; it is located north of the Denali fault and north of the Alaska Range. The area is mainly composed of alluvial fan deposits, abandoned flocd plain alluvium, swamp deposits and of flood plain alluvium in the vicinity of the aftershock area.

Some three to four miles north of the epicentral area is an area of perennially frozen silt, and to the north of that, the Birch Creek schist of the Yukon-Tanana plateau begins (see Pewé et al. 1966). Immediately north of the highest concentration of epicenters are some very small outcrops of intrusive igneous rocks and basalt.

No known fault crosses the surface here, however the authors think that there is a good possibility of a buried north-east, south-west trending fault (dipping to the south). Along this fault the aftershocks occurred. The trend of this possible fault is outlined on the surface by the forementioned outcrops (see Pewe et al. 1966). On the other hand the aftershock area is situated on the northern edge of a Bouguer gravity low. However, the orientation of this gravity low is WSW-ENE, about 45° to the trend of the posulated buried fault.

Seismicity

The general Fairbanks area had several severe shocks of magnitude 7 or over in the past 60 years, when seismic instrumentation existed to record such disturbances. The following table gives the most severe ones reported by Davis and Echols (1962).

Table 1 Severe Central Alaska Earthquakes

Date	Time	Coordinates		Magnitude
27 Aug 1904	21 56 06	64°N	151°W	7 3/4
7 July 1912	07 57 36	64°N	147°W	7.4
22 July 1937	17 09 29	64° 3/4 N	146° 3/4 W	7.3
16 Oct 1948	02 09 50	63.8°N	148°1 W	7

The last one however is not reported by Gutenberg and Richter (1954).

The energy release for Alaska had been calculated by Berg (March 1965) and the energy release map shows that on the average the Fairbanks area releases as much energy (10^{22} ergs/60 years/2° NS and 4° EW) as parts of the Aleutians.

Epicentral Area, Aftershocks

The occurrence of many aftershocks in the Fairbanks area led to the study reported here. Three seismic stations were operated in the immediate vicinity of the aftershock area to determine the hypocenter locations. Figure 2 shows the permanent telemeter station Pedro Dome together with the temporary stations ELI, GEO, BAD and CLB. Only three of these stations were occupied at any one time - there being no equipment available for more. The PJD station was recorded at the Geophysical Institute Telemeter terminal as was GEO. The viewer cf the Develocorder used at the telemeter terminal allows a time resolution better than 1/10 of a second. The third portable station was first operated at ELI on June 22-23 (GMT) in a mobile operation. The time reference was crystal and WWV controlled. Recording speed for several hours was approximately 30 cm/min. Figure 3 shows the first epicenters thus located. The next day (23-24 June GMT) the station at BAD was operated right in the epicentral area. Figure 4 shows the epicenters obtained that day during a few hours of recording.

A third location still further to the southeast (CLB, Fig. 2) was occupied on June 26/27. Epicenters located from that day are presented in Fig. 5. On 21 July high speed recording (30 cm/min) was carried out at BAD to see if there was any major shift in activity. Figure 6 shows the epicenters and depth of focus for the four well recorded earthquakes occurring on that day.

Despite the quite different position of the mobile station, there is no significant difference in either epicenter or focal depth determination.

The focal depth ranges from 6 to 19 1/2 km, with mostly 10-13 km. There is only one exception: the one shock recorded northwest of GEO and southwest of ELI (see Fig. 4) with depth > 25 km.

Crustal Velocities

Since most of the hypocenters fall in a depth range of 10-13 km, a single layer crust with V_p = 5.56 km/sec and V_s = 3.37 km/sec was assumed for the calculation (Jeffreys-Bullen first layer). Crustal structure investigation in the southern part of the Tanana Valley, close to the Alaska Range, revealed closely related P wave velocities of 5.27 and 5.80 km/sec in the upper part of the crust (to be reported in another paper).

For some of the best-recorded small shocks with clear P and S phases on all three stations, PJD, GEO, and BAD, the origin time determined from the S-P times and P arrivals and using the aforementioned velocities give differences for the origin time between stations of less than 0.1 sec. This difference would lead to a possible error of the hypocenter locations of the order of 1/2 km. However, it is thought that a more realistic error would be 2 to 3 km, based on origin time differences of 0.2 to 0.3 sec. The origin time error between stations not only includes possible reading and timing errors but also errors which might be introduced by a slide-rule calculation. Therefore, the J-B velocities must be a very close approximation in the upper part of the crust in the Fairbanks area.

Table of Aftershocks

Table 3 contains a reproduction of the telemeter network reading for the period from the first shock on June 21 to July 14. Only the major

aftershocks have been read on a routine daily basis. Some of the conventional MCK stations readings are also included. Figure 1 and Table 2 give the station locations.

Table 2

Name	Code	Latitude	Longitude	Altitude
Tanana	TNN	65°15.4'N	151°54.7'W	504 m
Big Mountain	BIG	59°23.4'N	155°13.0'W	562 m
Sheep Creek	SCM	61°50.0'N	147°19.7'W	1020 m
Pedro Dome	PJD	65°02.1'N	147°3C 5'W	740 m
Black Rapids	BLR	63°30.1'N	145°50.?'W	
McKinley	MCK	63°44.0'N	148°5F.0'W	

Because it was easier to reproduce all readings rather than select only the Fairbanks shocks, all have been included in the listing.

Explanation of Readings

Column 1-3: station code, disregard each line starting with ZAP. The line starting 000 contains the magnitude and tenths of magnitude for "local" shocks in columns 40 and 41, respectively.

Column 4 through 9: year, month, date

Column 10, 21, 32, 51, 59: indication of I (impulsive) or E (emergent) for the following phase.

Column 11-13: first ground motion, C-compression, D-dilation.

Column 14-20: arrival of first P phase; hours, min, sec, and tenth.

Column 25-31: arrival of second P phase; hours, minutes are not repeated unless changed.

Column 33-39: arrival of third P phase; hours, minutes are not repeated unless changed.

Column 52-58: arrival of first S phase; hours, minutes are not repeated unless changed.

Column 60-66: arrival of second S phase; hours, minutes are not repeated unless changed.

Acknowledgements:

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SEISMIC STATIONS

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❍   TELEMETER STATION
☉   OTHER STATION

Figure 1

Fig. 2 Permanent Station PJD
Temporary Stations ELI, GEO, BAD, CLB

CONTOUR INTERVAL 200 FEET
DASHED LINES REPRESENT 100 FOOT CONTOURS
DATUM IS MEAN SEA LEVEL
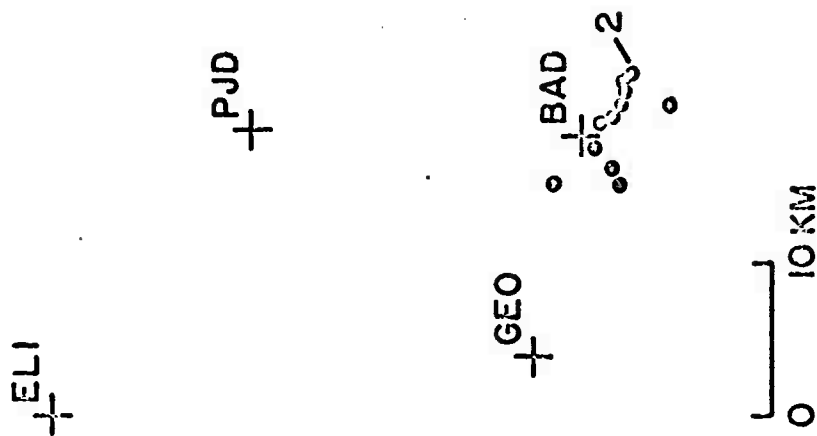
Fig. 3 Epicenters of small aftershocks. Stations used: ELI, PJD, GEO, 22–23 June 1967.
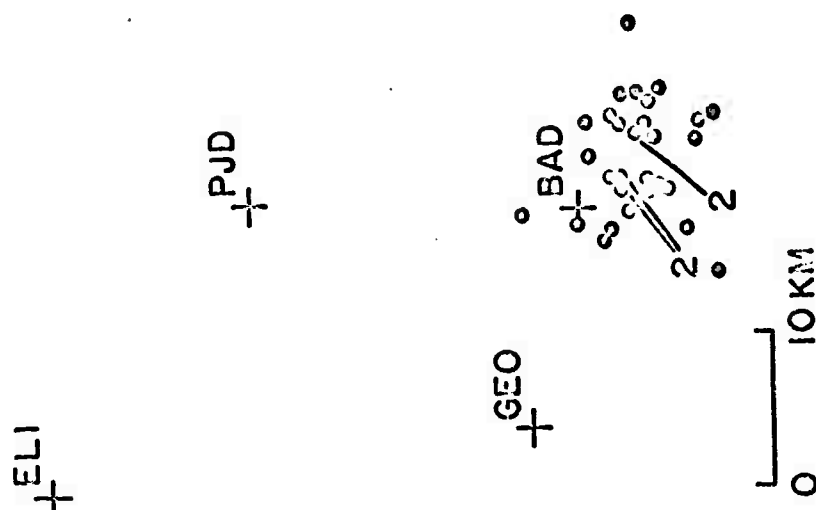
Fig. 4 Epicenters of small aftershocks. Stations used: PJD, GEO, BAD, 23-24 June 1967.
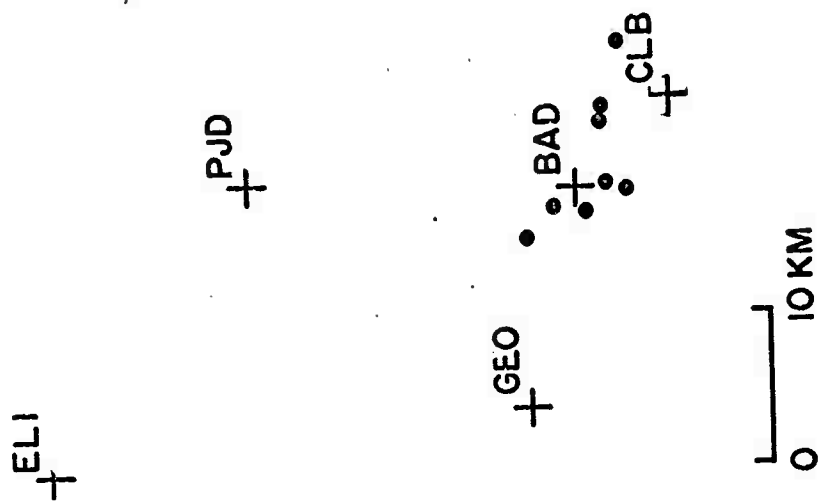
Fig. 5 Epicenters of small aftershocks, stations used PJD, GEO, CLB, 26-27 June 1967.

ELI
+

PJD
+

GEO
+

BAD
16° +
11 •° 12.5

° 7.5

0 └──────┘ 10 KM

Fig. 6 Epicenters of small aftershocks. Stations used PJD, GEO, BAD, 21 July 1967

Fig. 7 Hourly number of earthquakes recorded at PJD
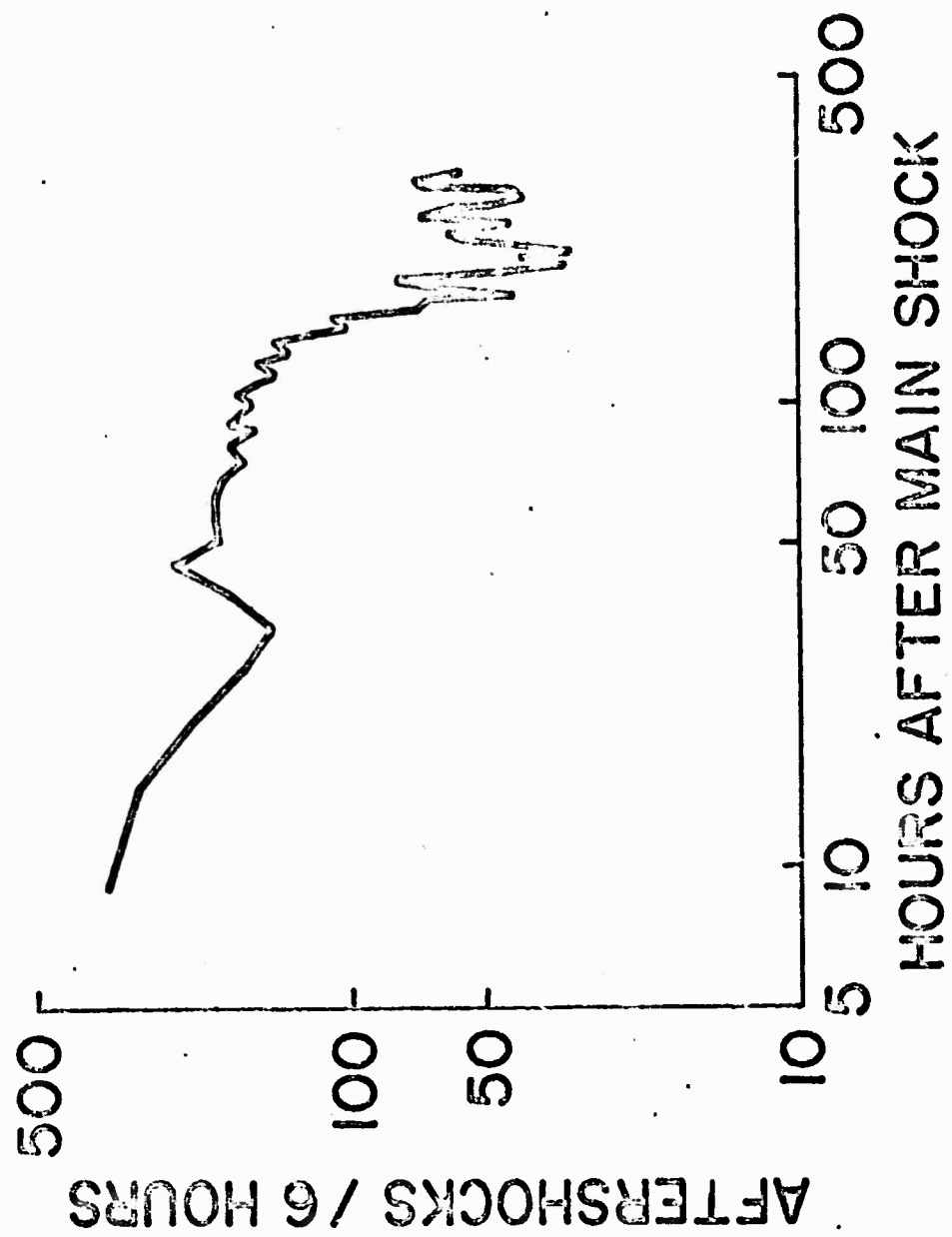
Fig. 8 6 hourly No. of earthquakes recorded at PJD.

TABLE 3

Station	Year	Date	First Motion	Time P	Time P	Magnitude (After 000 first 3 coi.) Others period of P.	Time S	Period of S	
00067	2			1806					
PJD67	62.			1804555					
MCK67	621.			1605129					
BLR67	621ID			1805146					
TNN67	621IC			1805222					
SCM67	621ID			1805375				~~	
BIG67	621EC			1806265				14450	
ZAP				2359					
00067	621			1814					
MCK67	621I			1813265					
BLR67	621ID			1813275					
SCM67	521ED			1813510					
BIG67	621I			1814404				14900	
ZAP				2359					
00067	621			1825					
MCK67	62'I			1825088					
BLRC7	621ID			1825111					
SCM67	621ED			1825325					
ZAP				2359					
BLR67	621I			1841415					
SCM67	621ID			1842087			463	11 12	
BLR67	621			1844429					
SCM67	621 D			1844534		I	322	8 6	
BLR67	621ID			1858205				2 60	
TNN67	621I			1858329					
PJD67	621I			1859313					
BLR67	621I			1905149				3 45	
TNN67	621E			1905249					
BLR67	621			1906404		I	594	3 12	
SCM67	621ID			1907024IC	068		451	8 11	
00067	621			1909			30		1
BLR67	621I			1909247				4240	1
TNN67	621ID			1909346					1
SCM67	621I			1909470				6 6	1
ZAP				2359					
00067	621			1913			26		
PJD67	621I			1912436					
BLR67	621ID			1913028				6210	1
TNN67	621			1913111					1
SCM67	621E			1913371				7 2	1
ZAP				2359					
BLR67	621I			1917163				3 10	
00067	621			1921					
PJD67	621I			1920347					1
BLR67	621I			1920564				3 57	1
TNN67	621E			1921064					1
ZAP				2359					
00067	621			1957			2b		
BLR67	621I			1957213				L18	
TNN67	621I			1957301					1
SCM67	621I			1957435				4 4	1
ZAP				2359					
00067	621			2005					
PJD67	621I			2004577					
BLR67	621I			2005169				4 75	
TNN67	621I			2005285					1
ZAP				2359					
00067	621			2035					
PJD67	621			2033041					
BLR67	621			2033231					

```
SCM67 621     2033476                                      11L17
ZAP           2359
00067 621     2059                    29                              1
PJD67 621I    2058473                                                 1
BLR67 621I    2059066                                      6195       1
TNN67 621I    2059176                                                 1
SCM67 621I    2059192ID    232                            7  4        1
ZAP           2359
00067 621     2109                    31.                             1
PJD67 621I    2108509I                                                1
BLR67 621I    2109109                 I    331            4420        1
TNN67 621I    2109184                                                 1
ZAP           2359
BLR67 621I    2149178                      380            4540        1
SCM67 621     2149404I     444                            8 12        1
00067 621     2154                    31                              1
PJD67 621     2153563                                                 1
BLR67 621ID   2154153                                     4255        1
TNN67 621ED   2154230      279                                        1
SCM67 621ID   2154403                                     7  5        1
ZAP           2359
BIG67 621ID   2217003 TEL                                             1
SCM67 621ID   2217207 TEL                                             1
BLR67 621ID   2217297 TEL             7 28                            1
TNN67 621ID   2217310 TEL                                             1
PJD67 621ID   2217332 TEL                                             1
00067 621     2231                    37                              1
PJD67 621I    2230364                                                 1
BLR67 621ID   2230567ID    587                                        1
TNN67 621ID   2231042                                                 1
SCM67 621ID   2231210ID    255                            5 45        1
ZAP           2359
00067 621     2332                    49                              1
PJD67 621I    2331526                                                 1
BLR67 621ID   2332115IC    134                                        1
TNN67 621IC   2332193                                                 1
SCM67 621ID   2332347I     361IC   404                    11165       1
ZAP           2359
BIG67 621ID   2337311                                                 1
SCM67 622E    0119599                      375            4 13
00067 622     0128
PJD67 622I    0128141
BLR67 622E    0128278                 E    54             2 21
SCM67 622     012835
ZAP           2359
00067 622     0158
PJD67 622I    0158310
BLR67 622E    015852                                      2 20
TNN67 622     0158497
ZAP           2359
00067 622     0228
PJD67 622ID   0228299
GEO67 622IC   0228292E     308        E    3211    329
BLR67 622ID   0228519                 E    2907           3120
TNN67 622EC   0223583
ZAP           2359
00067 622     0244
GEO67 622IC   0243461                 I    490
PJD67 622ID   0243468
BLR67 622E    0244093                 E    26             4 45
```

```
ZAP              2359
00067 622        0305
GEO67 622IC      0304376                          E    405I    409
PJD67 622I       0304385
BLR67 622I       0305001                                            2 30
TNN67 622ED      0305109
ZAP              2359
00067 622        0028        648    1477    37
PJD67 622I       0028011
BLR67 622I       0028207
TNN67 622ED      002828
SCM67 622E       002844                            2926            2135
ZAP              2359
00067 622        0031                       36
PJD67 622I       0031091
BLR67 622E       0031299
TNN67 622E       0031355
SCM67 622E       003151                            3234             8 16
ZAP              2359
00067 622        0046        648    1472    31
PJD67 622ID      0045271
BLR67 622IC      0045487
TNN67 622E       0045551
SCM67 622E       0046081                              53             6  9
ZAP              2359
00067 622        0100                       31
PJD67 622I       0100069
BLR67 622E       0100297
TNN67 622E       010036
SCM67 622E       010054                         E   01346           6  8
ZAP              2359
00067 622        0119                       31
PJD67 622I       0119123
BLR67 622        011933
TNN67 622        011939
ZAP              2359
00067 622        0306
GEO67 622E       0305485
PJD67 622I       0305499                     2 90
TNN67 622E       0305342
BLR67 622E       0306201
ZAP              2359
00067 622        0317
GEO67 622E       0316424
PJD67 622I       0316434
BLR67 622E       0317041                     2 35
TNN67 622E       0317148
ZAP              2359
00067 622        0332
GEO67 622I       0332081
PJD67 622I       0332089
BLR67 622E       0332314
TNN67 622E       0332291                     2 45
ZAP              2359
00067 622        0340
GEO67 622I       0339568
PJD67 622ID      0339585
BLR67 622E       034017                      2 55
TNN67 622E       0340249
ZAP              2359
00067 622        0511
```

```
GEO67  622I    0510318
PJD67  6221    0510335
BLR67  622E    0511241
TNN67  622E    0511101
SCM67  622E    0511271                              3 15
ZAP            2359
00067  622     1659                          35
PJD67  622ID   1658465
BLR67  622E    1659069
TNN67  622E    1659142
SCM67  622E    1659301                                      4 15
ZAP            2359
00067  622     1410                          38
PJD67  622     1409521
BLR67  622     1410111
TNN67  622     1410172
SCM67  622     1410349                                      4  5
ZAP            2359
00067  622     1859                          50
PJD67  622ID   1857410
BLR67  6221C   1858003
TNN67  6221D   1858073
SCM67  6221C   1858234
BIG67  622E    1859121                                    10 12
ZAP            2359
00067  622     2020                          35
PJD67  6221D   2019214
BLR67  622E    2019406
TNN67  622E    2019470
SCM67  622E    2020034                                      8 12
ZAP            2359
00067  622     2117                          38
PJD67  6221D   2117008
BLR67  622ED   2117208
TNN67  622E    2117281
SCM67  622EC   2117441                                      4 45
ZAP            2359
00067  622     2308                          34
PJD67  6221D   2308170
BLR67  6221D   2308364I       382
TNN67  6221C   2308440I       482
SCM67  622E    2308591                                      4 22
ZAP            2359
00067  623     0307                          27                         3
GEO67  623I    0307082         I     111                                3
PJD67  623I    0307087                                                  3
BLR67  623E    0307291         E     501                                3
TNN67  623E    0307368E     401                                         3
SCM67  623E    0307526                                      3  7        3
ZAP            2359
00067  623     0354                                                     3
GEO67  623I    0353537                       28                         3
PJD67  623ID   0353553                                                  3
BLR67  623E    0354116      247 E                                       3
TNN67  623EC   0354209                                                  3
SCM67  623E    0354350                                      3 11        3
ZAP            2359
00067  623     0607                          43                         3
GEO67  6231C   0606279
PJD67  623I    0606293
BLR67  6231D   0606471
```

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TNN67 623ED  0606528
SCM67 623EC  0607097                                      90
ZAP          2359
00067 623    0643                        36
GEO67 623EC  0643046
PJD67 6231D  0643057
BLR67 623E   0643253
TNN67 623E   0643328
SCM67 623E   0643499                                          5 25
ZAP          2359
00067 623    1156                        52
GEO67 6231C  1154366
PJD67 6231   1154379
BLR67 6231D  1154479
TNN67 6231C  1155045
SCM67 623ED  1155201
BIG67 623EC  1156098                                          5 60
ZAP          2359
00067 623    2011                        37
GEO67 6231D  2010446
PJD67 623    201 47
BLR67 623    2011055
TNN67 623    2011129
SCM  623     201128                                           6 30
ZAP          2359
00067 624    0143                        30                           6
SCM67 624E   0143241                                                  6
BLR67 624E   0143437                                                  6
TNN67 624E   0143480                                                  6
PJD67 624E   0143500                                         4 18     6
BIG67 624    0143502              E  44324                            6
ZAP          2359
00067 624    1103     GRS648     1477    43                           6
GEO67 6241   1103005
PJD67 6241   1103018
BLR67 624E   1103223E       242                   444
TNN67 624E   1103285
SCM67 624E   1103451     457                                 10 40
ZAP          2359
SCM67 624E   1341178 TEL                                              6
BLR67 624E   1341262 TEL                                              6
TNN67 624E   1341268 TEL                                              6
PJD67 624E   1341296 TEL                                              6
BLR67 624E   1438154ETEL    366                                       6
PJD67 624E   1438370ETEL    458                                       6
TNN67 624E   1438250ITEL                                              6
00067 624    1956                        30                           6
GEO67 624E   1955348                                                  6
PJD67 6241   1955368                                                  6
BLR67 6241C  1955467                                                  6
TNN67 624E   1956073                                                  6
SCM67 624E   1956180E    231                 I    430        3 14     6
ZAP          2359
00067 624    2013                        28                           6
GEO67 6241   2012386                                                  6
PJD67 6241D  2012398                                                  6
BLR67 624E   2013014                                                  6
TNN67 624E   2013100                                                  6
SCM67 624E   20132411    285                 E  14074       4 5      6
ZAP          2359
BIG67 624E   2111077 TEL                                              6
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SCM67 624E    2111359 TEL                                                    6
BLR67 6241D   2111418 TEL                                                    6
TNN67 624ID   2111292 TEL                                                    6
PJD67 624E    2111384 TEL                                                    6
00067 624     2342                                                           6
PJD67 6241D   2342196                          I    225                      6
BLR67 624E    2342417                          I   4.0.          2 30         6
TNN67 624E    2342506                                  5                     6
ZAP           2359                                                           6
00067 624     2250                                                           6
PJD67 6241D   2250020                     0                                  6
BLR67 624E    2250222IC       246             I    444          452 4240     6
TNN67 624E    2250283E       334                                            6
SCM67 624E    2250462                                                        6
ZAP           2359                                                           6
00067 624     2343                                                           6
PJD67 6241D   2342404                     0                                  6
BLR67 624ED   2343031                          E    2008        225 2 60     6
TNN67 624E    2343124                                                        6
ZAP           2359                                                           6
00067 624     2345                                                           6
PJD67 6241D   2344555                     0                                  6
BLR67 6241C   2345176                          E    368            2 17      6
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GEO670630I	0054156								
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BLR670630E	0054370						59		
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SCM670630E	005501					E	43	6	5
ZAP	2359								
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SCM670630IC	0413246					E	375	1	11
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GEO670630E	0519260								
PJD670630I	0519271								
BLR670630E	0519500								
TNN670630E	0519550								
SCM670630E	052014							6	5
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GEO670630IC	0731190								
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TNN670630E	0731524								
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SCM670630ID	1051452							2	8
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BIG670630ED	141116							3	17
SCM670630ID	1411233I		27					2	25
BLR670630IC	1411468					E	1233		
TNN670630E	141156								
PJD670630IC	1411579								
ZAP	2359								
SCM670630ED	1650493					I	51036	2	11
SCM670630ID	1730324						37	1130	
BLR670630ID	1730592						3124	4	12
SCM670630ED	1810575						1110	2	7
BLR670630E	181121					E	496	3	11
BIG670630ED	1929232					I	290	2	5
BIG670630EC	1934044	TEL		8	4				
SCM670630E	193453	TEL		8	7				
PJD670630EC	193500	TEL		6	7				
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GEO670630I	2009530								

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GEO67 7 1     0057C52
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BLR67 7 1ID   0057252                              I    428              3L 3
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PJD67 7 1ID   0141111
BLR67 7 1IC   0141288I        307
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SCM67 7 1E    0141529
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BLR67 7 1E    0156347                              I    538              3L 4
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SCM67 7 1ID   0156567
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GEO67 7 1ID   0518461                              I    486
PJDC7 7 1I    0518480
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SCM67 7 1ED   0519298ID      346                                         3  6
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00067 7 1     1235
PJD67 7 1     1235269                    28
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ZAP           2359
BIG67 7 1IC   1450124                              I    258              2 30
BIG67 7 1IC   1559563        583                   I    101              2 11
00067 7 1     1843
GEO67 7 1I    1842305
PJD67 7 1I    1842320
BLR67 7 1IC   1842540                              I    136              6 75
TNN67 7 1     1843027
ZAP           2359
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SCM67 7 1IC   2124416 TEL
BLR67 7 1E    2125042 TEL
00067 7 1     2217                       33
GEO67 7 1ID   2216515
PJD67 7 1I    2215027
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SCM67 7 11D  2312176 TEL
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TNN67 7 11D  2312457 TEL
PJD67 7 11D  2312503 TEL
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SCM67 7 2EC  005734  TEL              3  24
BLR67 7 2E   0057575 TEL              5  17
B!G67   2E   011053  TEL              3   2
SCM67 7 2E   011148  TEL              4  18
BLR67 7 2EC  011213  TEL              5   9
PJD67 7 2E   011222  TEL              5   3
BIG67 7 2E   015241  TEL              3   1
SCM67 7 21D  0153372 TEL              4   8
BLR67 7 21D  0154014 TEL              6  11
BIG67 7 2EC  022251  TEL              2   3
SCM67 7 21D  0223480 TEL              4  27
BLR67 7 2E   022410  TEL              6  10
PJD67 7 2E   022420  TEL              4   4
BIG67 7 2EC  0237344 TEL              3   4
SCM67 7 2ED  0238294 TEL              3  26
BLR67 7 21D  0238545 TEL              5  13
PJD67 7 21C  0239034 TEL              3   5
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SCM67 7 2EC  0326482                                         7360
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PJD67 7 21D  0327080
BIG67 7 21D  0327126                                41          7 45
ZAP          2359
BIG67 7 2EC  0709214 TEL
PJD67 7 21   0710128 TEL
SCM67 7 2E   071016  TEL
BLR67 7 21C  0710414 TEL
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SCM67 7 2E   071715  TEL              8   2
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PJD67 7 2ED  0844257 TEL              9   7
BLR57 7 2ED  0844346 TEL             10  13
BIG67 7 2ED  084438  TEL              7   3
00067 7 2    0919                    23
GEO67 7 21D  0918535                                558
PJD67 7 21   0918550
BL.   7 2ED  0919145
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SCM67 7 21D  0919390                                         4  3
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BLR67 7 2E   1011454
TNN67 7 2E   101149
PJD67 7 2E   101155
BIG67 7 2ED  1051410                            I    552        2 75
BIG67 7 21C  1117342                            I    476        2 22
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BIG67 7 21     1220412                                         58
BLR67 7 21C    1221068
SCM67 7 2ED    1221118                                         54              5200
TNN67 7 2FD    1221400
PJD67 7 2ED    122144
ZAP            2359
SCM67 7 2E     133244   TEL              12   2
PJD67 7 2E     133249   TEL              12   3
BLR67 7 2E     1332535  TEL              14   4
00067 7 2      1335                      33
GEO67 7 21C    1334424                                I    452
PJD67 7 21     1334438
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TNN67 7 2E     1335086
SCM67 7 2ED    1335242          296                                           5 18
ZAP            2359
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BIG67 7 2ED    1624320  TEL               6   2
00067 7 2      1625                       29
GEO67 7 21C    1624448
PJD67 7 21     1624460
BLR67 7 2EC    1625068                                         25
TNN67 7 2E     162518
SCM67 7 2E     162529                                          26115          6  5
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00067 7 2      1903          632    1505   23
SCM67 7 21C    1902590                                         0326           2 17
TNN67 7 2ED    1903012
BLR67 7 2E     190302
PJD67 7 2EC    1903032
ZAP            2359
BIG67 7 2ED    2043565  TEL               8   3
PJD67 7 2ED    2044169  TEL               6  10
SCM67 7 2ED    2044210  TEL               9   3
BLR67 7 2ED    2044228  TEL               6   6
SCM67 7 2E     221046   TEL              12   2
00067 7 3      0006          607    1506   30
SCM67 7 3E     0006183                                                        4 45
BIG67 7 3E     000629                                 E    0705               3 12
BLR67 7 3E     0006430
PJD67 7 3E     000654
ZAP            2359
SCM67 7 3ED    01493931         400                   E    516                2  9
BLR67 7 3EC    0150014                                                        4 10
SCM67 7 3IC    0218045          058                                           2  8
BLR67 7 3E     0218315
SCM67 7 3E     0237530                                         3811           2  8
00067 7 3      0244          606    1515   25
BIG67 7 3ID    0242387                                I    580                3 10
SCM67 7 3E     024342
BLR67 7 3E     024406
PJD67 7 3E     024415
ZAP            2359
BIG67 7 3EC    0300062  TEL               3   6
SCM67 7 3E     030102   TEL               3  27
BLR67 7 3EC    0301258  TEL               6  12
PJD67 7 3EC    0301350  TEL               3   5
BLR67 7 3E     035328   TEL                   7
PJD67 7 3EC    0517118  TEL               6   9
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SCM67 7 3IC  0533404                          E    51          3210
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PJD67 7 3ID  0534087
TNN67 7 3E   053415
BIG67 7 3E   053429                                            4   7
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SCM67 7 3ID  0636381                          E   504          3 75
BLR67 7 3ID  0637004                               28         4120
PJD67 7 3EC  0637125
TNN67 7 3E   063718
BIG67 7 3E   063728                           I 38205          4   6
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BIG67 7 3IC  0655563 TEL                2 19
SCM67 7 3EC  065651  TEL                4  5
BLR67 7 3E   065715  TEL                2  7
TNN67 7 3E   065720  TEL
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BIG67 7 3EC  093426  TEL                6  7
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SCM67 7 3E   094148  TEL                4 24
BLR67 7 3ID  0942118 TEL                5 10
PJD67 7 3E   094221  TEL                4  8
SCM67 7 3E   1155098                          I   228          2 13
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SCM67 7 3ID  1600018                          I   084          2 22
00067 7 3    1715
SCM67 7 3ED  1715282                          I   446          4 12
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PJD67 7 3E   171546                           I 47102    13  2 75
ZAP          2359
BIG67 7 3IC  2146584                          I 47102    13  2 75
00067 7 3    2251                       30
GEO67 7 3ID  2251106                          I   132
PJD67 7 3ID  2251114
BLR67 7 3EC  2251343
TNN67 7 3E   225139
SCM67 7 3E   2251568                                           4 10
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00067 7 4    0222    CGS587   1536   42
BIG67 7 4ID  02210201     042                 I   159          2600
SCM67 7 4EC  0221498                                          10 12
BLR67 7 4E   022214                                            8 13
PJD67 7 4E   022224
ZAP          2359
00067 7 4    0231
SCM67 7 4IC  0231022                               23         3  8
BLR67 7 4IC  0231091
PJD67 7 4ID  0231143
ZAP          2359
00067 7 4    0315                       27
GEO67 7 4ID  0314315                               347
PJD67 7 41   0314320
BLR67 7 4E   0314537
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PJD67 7 4E    0443585                         I   4430              2 17
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SCM67 7 4ID   0515596
BLR67 7 4ED   0516212                                              4 10
PJD67 7 4E    051632
ZAP           2359
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SCM67 7 4IC   0804224                                              2 22
BLR67 7 4IC   0804442                                              4 11
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ZAP           2359
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GEO67 7 4E    1125184
PJD67 7 4I    1125201
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SCM67 7 4E    112604                          E   45               6   4
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PJD67 7 4E    133420
ZAP           2359
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PJD67 7 4EC   1610460
ZAP           2359
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GEO67 7 4IC   1642118                              145
PJD67 7 4I    1642132
BLR67 7 4E    164233
TNN67 7 4F    164240
SCM67 7 4EC   1642558                                             7   8
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SCM67 7 51D   1038064
BLR67 7 51D   1038304                                    544
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GEO67 7 5E    1119155                                    186
PJD67 7 51    1119168
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TNN67 7 5E    111943
SCM67 7 5E    1120019                                                3 11
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PJD67 7 5ED   1352178 TEL                     4  5
SCM67 7 5EC   1352192 TEL                     8  5
BLR67 7 51C   1352232 TEL                     4 10
BIG67 7 5E    1524091                              I  210           2 10
00067 7 5     1916                            32
GEO67 7 5E    1915409                              I  434
PJD67 7 51    1915416
BLR67 7 5E    191603                               I  224
TNN67 7 51D   1916094
SCM67 7 5E    191627                                                 4 17
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PJD67 7 51    2043327
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TNN67 7 5E    2044004
SCM67 7 5E    204421                                                 10  4
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PJD67 7 5     221057
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SCM67 7 61D   0505246
BLR67 7 61D   0506371
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SCM67 7 6E    131621                                       3 10
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SCM67 7 6EC   134547   TEL             13 21
TNN67 7 6ID   1345593  TEL             13 11
BLR67 7 6E    134606   TEL             13  8
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SCM67 7 6      135017   TEL
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PJD67 7 6      135042   TEL
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PJD67 7 6IC   1548012
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TNN67 7 6E    154829
SCM67 7 6E    154845                                       6  4
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BIG67 7 6E    2118332                      I   4591    482 2  6
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SCM67 7 7EC   0042160                                      2 11     2
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BLR67 7 7EC  0132302
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SCM67 7 7ED  0400218                                             6 12
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PJD67 7 7E   075545
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PJD67 7 7ED  0954008 TEL                      7 15
SCM67 7 7IC  1207388                                    452      1 60
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00067 7 7    1512     639    1489   19
PJD67 7 7E   1512312                               I    482      5 15
BLR67 7 7EC  1512325                                            3 15
TNN67 7 7E   1512401
SCM67 7 7E   1512453
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00067 7 7    1553     620    1472   13
SCM67 7 7ID  15523381       364                                 2200
BLR67 7 7IC  1552578
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TNN67 7 7IC  1553308
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PJD67 7 7IC  1710382
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PJD67 7 7ID  1758116                                 15
SCM67 7 7E   1758160                                 297         3  9
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ZAP          2359
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GEO67 7 7E   203509                                  118
PJD67 7 7E   203510
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TNN67 7 7E   203536
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13. ABSTRACT

Aftershock recordings have been obtained to determine the extent of the fracture area which using some 50 shocks, was found to be an area of 10 x 15 km with the major axis roughly oriented in a NW-SE direction. Hypocenter depth varies from 6-19 km, with most of the shocks being confined to a depth of 10 to 13 km. It was found that the Jeffreys-Bullen velocities, V_p = 5.56 and V_s = 3.37 km/sec, represent a close approximation of the velocities in the area. Presented also are the telemeter network readings from June 21, 1800 GMT to July 14. These readings include the aftershocks of magnitude 2.5 and upward.

DD FORM 1473, 1 NOV 65

14. KEY WORDS	LINK A		LINK B		LINK C	
	ROLE	WT	ROLE	WT	ROLE	WT
Hypocenter						
Aftershocks						
Magnitude						
Seismicity						